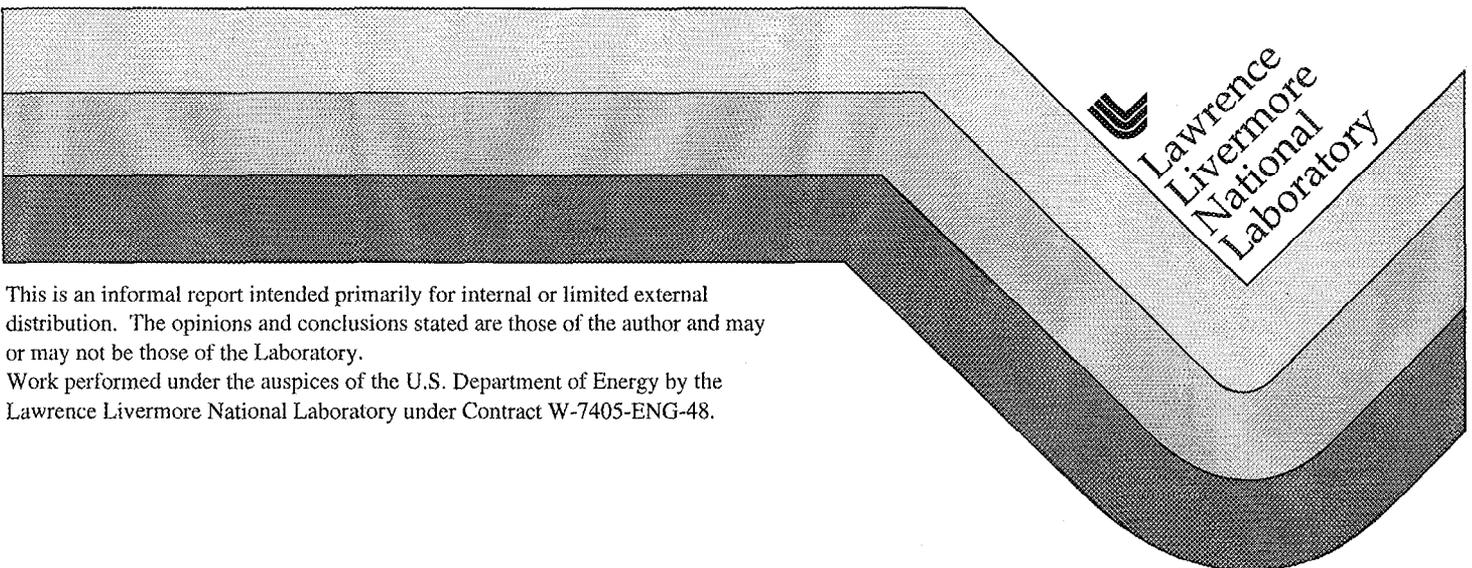


# User-Calibration of Fowler Ultra-Cal Mark III Digital Caliper

J. Estill

September 19, 1996



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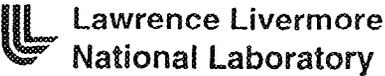
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# YUCCA MOUNTAIN PROJECT

## Technical Implementing Procedure

No.: TIP-CM-05  
Revision: CN TIP-CM-05-0-1  
Effective Date: 09/19/96  
Page: 1 of 4

Subject: User-Calibration of Fowler Ultra-Cal Mark III Digital Caliper

AUTHOR: J. Estill

Training Required: Yes  No

Comments: Text changes for clarification only.

### REVISION HISTORY

<u>Rev. No.</u>	<u>CN No.</u>	<u>Effective Date</u>	<u>Description of Revision/CN</u>
0		07/02/96	Initial Issue
0	TIP-CM-05-0-1	09/19/96	Minor text changes for clarification only. Affects Title Page and pages 2 and 3 of 4.

Approved by: W. D. Calame 9/19/96  
CRWMS-LLNL Manager Date

Approved by: Roy Mudge 9-17-96  
M&O LLNL Quality Assurance Manager Date

Approved by: R. Daniel McCarty 17 Sept 1996  
Technical Area Leader Date

No.:	Revision:	Date:	Page:
TIP-CM-05	CN TIP-CM-05-0-1	09/19/96	2 of 4

## 1.0 PURPOSE

The purpose of this technical implementing procedure (TIP) is to describe the procedure that will be employed for user-calibration of a digital caliper used in the determination of specimen dimensions. A caliper is used for some of the activities of the Scientific Investigation Plan (SIP) "Metal Barrier Selection and Testing" (SIP-CM-01, WBS # 1.2.2.5.1). In particular, it will be used for Activity E-20-50, "Long-Term Corrosion Studies."

## 2.0 SCOPE

This procedure describes the methodology for user calibration of a Fowler Ultra-Cal Mark III digital caliper. National Institutes of Standards and Technology (NIST) traceable gauge blocks are employed in the calibration procedure.

## 3.0 RESPONSIBILITIES

The Principal Investigator (PI) or designee is responsible for the conduct of the activities and methods described in this procedure, and maintaining scientific notebooks and/or electronic recording media.

The Technical Area Leader (TAL) is responsible for verifying that this procedure meets the objectives of the SIP "Metal Barrier Selection and Testing" (SIP-CM-01, WBS # 1.2.2.5.1) and its associated Activity Plans.

The YMP Quality Assurance Manager is responsible for monitoring the implementation of this TIP and for assuring the continuing effectiveness of the applicable controls.

## 4.0 TEST EQUIPMENT

- A. Fowler Ultra-Cal Mark III Digital Caliper, (serial number **11497**) or **spare set suitably identified with unique serial number** (resolution of 0.001 inches or 0.01 mm)
- B. Fowler English Gauge Blocks with NIST Traceable Standard Certifications. Sandia National Laboratory Standards Laboratory Certificate. Recall No. SNL-2278, date tested: June 13, 1996, expires on: June 13, 1998. (Appendix A)

## 5.0 HANDLING OF GAUGE BLOCKS

- A. The user will wear clean cotton gloves when handling the gauge blocks.
- B. The user will handle the gauge blocks so as not to damage them.
- C. The gauge blocks will be stored in a safe and secure location.

## 6.0 CALIPER OPERATION

- A. Turning caliper off/on: depress right front button for > 2 sec
- B. Change caliper mode (Mode 1 $\Leftrightarrow$  Mode 2): depress left front button for > 2 sec
- C. Mode 1 (display shows: "mm" or "inch" in lower left and "set" in lower right)
  - 1. zeroing: depress right front button briefly (< 1sec) ("REF1" appears in upper right of display)
  - 2. changing units: depress left front button briefly (< 1 sec)
- D. Mode 2 (display shows: "REF1" in upper left)
  - 1. data transfer to computer: depress left front button briefly (<1sec)

## 7.0 CALIBRATION PROCEDURE

- A. Record certified dimensions, including tolerances, of gauge block standards, the calibration certification numbers, the certification date, and any other pertinent information. This information needs only to be entered once into the scientific notebook or electronic database, that is, it is not necessary to enter this information each time the digital calipers are calibrated.
- B. Zero the Digital Caliper
  - 1. **Wipe the jaws with a lint-free cloth dipped in isopropanol.**
  - 2. Slide caliper completely to the left until measuring surfaces contact each other.
  - 3. Zero the caliper reading (see section 6.0)
- C. Measure calibrated gauge blocks and record the measurements.

Gauge blocks with nominal dimensions close to the specimen dimensions shall be measured.

The following operations shall be repeated for each gauge block:

Open the calipers nominally 0.5 inches greater than the gauge block to be measured. With surfaces of gauge block perpendicular to the caliper measuring, slide the calipers to the left until they contact the specimen. Record the measurement.

## 8.0 FREQUENCY OF CALIBRATION

The caliper will be calibrated by a user prior to obtaining measurements of a specimen or a set of specimens.

A rechecking of the caliper calibration shall be performed at completion of each set of measurements.

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## 9.0 OUT OF CALIBRATION

Out of calibration equipment will be handled as specified by QP 12.0, "Control of Measuring and Test Equipment". If there is a drift of the measured readings of the gage blocks of more than  $\pm 0.002$  inches, then the digital caliper cannot be used for this activity until they are repaired and read within the acceptable range ( $\pm 0.002$  inches).

## 10.0 TRAINING

Personnel responsible for the measurement of test specimens in the applicable activities of SIP "Metal Barrier Selection and Testing" (SIP-CM-01, WBS # 1.2.2.5.1) shall be trained to this TIP. In particular, this TIP applies to Activity E-20-50, "Long-Term Corrosion Studies."

## 11.0 QUALITY ASSURANCE RECORDS

The following are retained as Quality Assurance records:

- scientific notebook and/or an electronic database (e.g. Microsoft Access)
- the calibration certificates of the NIST traceable standards
- any Nonconformance Reports resulting from calibration

Calibration records governed by this TIP shall be maintained in the scientific notebook and/or appropriate electronic media.

## 12.0 ASSOCIATED ACTIVITY AND TIPS

This TIP can be used in the activities of the of SIP "Metal Barrier Selection and Testing" (SIP-CM-01, WBS # 1.2.2.5.1). In particular it may be used in

- Activity E-20-50, "Long Term Corrosion Studies"
- Activity E-20-47, "Thermogravimetric Studies"

Associated TIPs include:

- TIP-CM-04, "User-Calibration of Mettler AT200 Analytical Balance"
- TIP-CM-03, "Electronic Weight-and-Dimensional-Data Entry in a Computer Database"

## 13.0 APPENDIX

Appendix A - Standards Laboratory Certificate for gage blocks

Appendix B - Operating manual of the Fowler Ultra-Cal Mark III Digital Caliper.



# Standards Laboratory Certificate

English Gage Blocks  
Mfgr. Fowler  
3 pc. set, .125 to 2 inches

Tested for: LLNL  
Date tested: June 13, 1996  
Expires on: June 13, 1998

Recall No.: SNL-2278  
Serial No.: None  
Grade: A+

The gage blocks in this set were checked for conformance to Federal Specification GGG-G-15C. Length and parallelism were checked by mechanical comparison at 68 degrees F. to gage blocks certified by the Primary Standards Laboratory, Sandia National Laboratories, Albuquerque, New Mexico. A copy of the measured values is attached.

The estimated uncertainties of the measured values are:

Up to and including	1 inch .....	+/- 4 microinches
	2 inch .....	+/- 5 microinches

The gage blocks in this set are expected to remain within the estimated uncertainty during the calibration interval provided they are not physically damaged.

Certified by: E. A. Bryce, 1484-1

Copy to:

Lawrence Livermore National Laboratory  
P.O. Box 808  
7000 East Ave.  
Livermore, California 94550

GAGE BLOCK INSPECTION CERTIFICATE

MAKE OF SET: Fowler

SET S/N: SNL-2278

DATE: 05/17/96

GRADE OF SET: E1

SET SIZE: 3

RECALL NO. SNL-2278

BLOCK SHAPE: square

SET UNITS: inch

BLOCK MATERIAL: steel

deviations & parallelism in  $\mu$  inches

SERIAL NO.	NOMINAL SIZE	DEVIATION	PAR. ERROR	SERIAL NO.	NOMINAL SIZE	DEVIATION	PAR. ERROR	SERIAL NO.	NOMINAL SIZE	DEVIATION	PAR. ERROR
9637	0.125000	0.6	0.5								
9606	1.000000	1.5	0.5								
C649	2.000000	0.4	0.9								

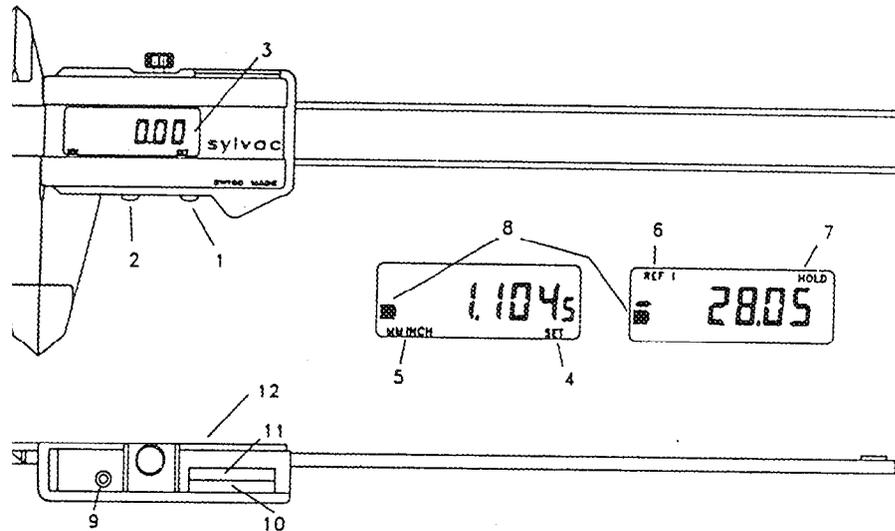
\*\*\* 2 X tol. exceeded. \*\* tol. + unc. exceeded. \* tol. exceeded

INSPECTED BY: E.A. Bryce  
 TESTED FOR.: LLRL

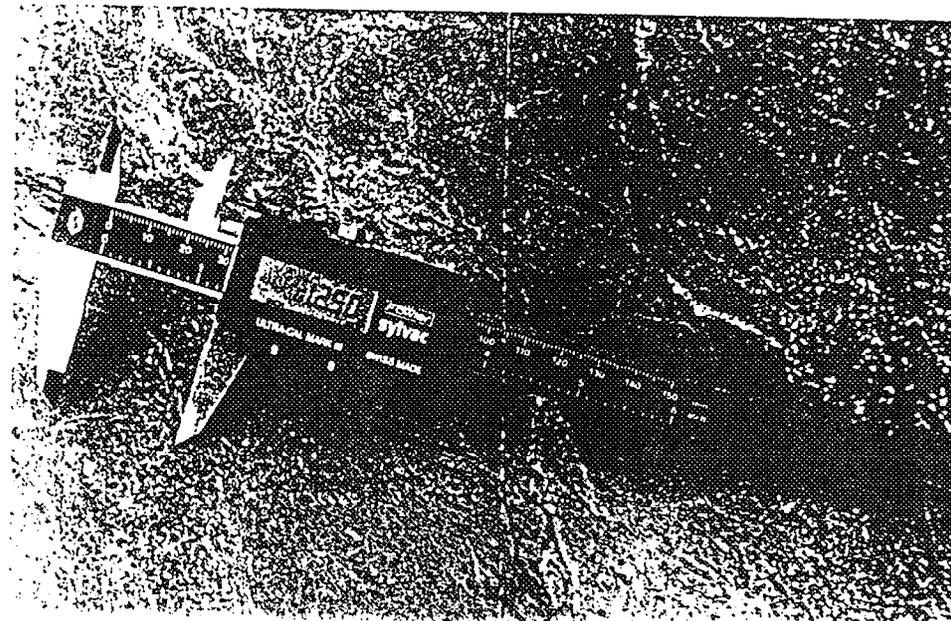
FILE NAME: snl2278  
 REF. STAND.: 11453



Features:



# Caliper Ultra-Cal Mark III



Press-button for: ON/OFF, zero setting and memory (HOLD)

Press-button for: mm/inch conversion and mode selection

Combined display:

- 1. Shows function of button 1
- 2. Shows function of button 2
- 3. Indicates mode selected through 2
- 4. Indicates the measurement selected for memory (hold)
- 5. Portrays termination of battery life

Reset port

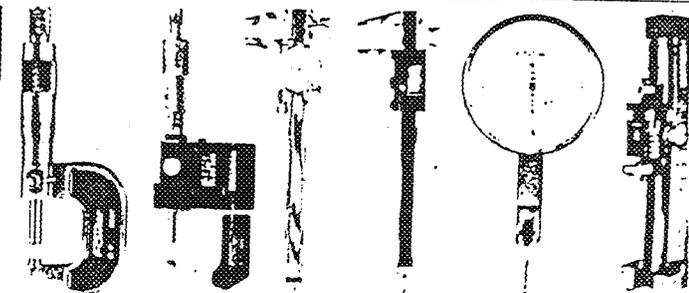
Cable connection for RS-232 data output

Flip-off" panel for easy battery exchange

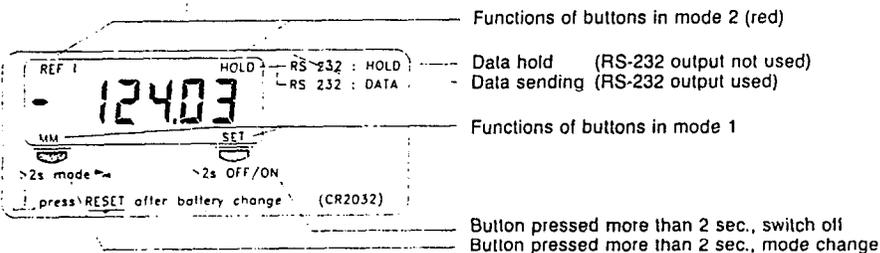
Port instruction plate



Fred. V. Fowler Co., Inc.  
66 Rowe St. P.O. Box 299  
Newton, MA. 02166  
Phone 617 / 332-7004  
Fax 617 / 332-4137



## Explanation of instruction plate



## Technical specifications:

Measuring range:	Internal 0-150 mm, 0-6" / 0-200 mm, 0-8" External 0-150 mm, 0-6" / 0-200 mm, 0-8" Depth 0-150 mm, 0-6" / 0-200 mm, 0-8" Shoulder 0-150 mm, 0-6" / 0-200 mm, 0-8"
Resolution:	0.01 mm / 0.0005"
Accuracy:	30 $\mu$ m / 0.001" (Ultra-Call Mark III/6") 40 $\mu$ m / 0.0015" (Ultra-Call Mark III/8")
Repeatability:	10 $\mu$ m / 0.0005" ( $\pm$ 2 s)
Operational speed:	1,5 m/sec. / 60"/sec.
Measuring units:	metric or english (mm/inch), true conversion
Measuring system:	capacitive SYLVAC measuring system (patented)
Display:	LCD, minus sign (-), 6 digits (+ 0.5 mil in inch) height of digits 6 mm / 0.24"
Power supply:	one lithium battery 3V, Type CR2032, capacity: 190 mAh
Type of batteries:	Toshiba CR2032                      Maxell CR2032 Renata B/CR2032                  Sanyo CR2032 Ucar CR2032                        Panasonic CR2032 Rayovac CR2032                  Varta CR2032
Battery life:	2 years when normally used. (2000 work hours per year). When (B) is displayed, the remaining battery life is more than one day. To protect the environment, please dispose the dead batteries into an appropriate container.
Working temperature:	5°C to 40°C / 41 to 104 degrees F
Output:	direct RS232
Interface:	RS232 compatible interface cable with optoelectronic coupler (Order code: 926.5521/2/3)
Construction:	hardened and ground stainless steel
Weight:	150 g

## Starting the caliper

A brief press of button (1) will switch ON the caliper unit.  
Having switched on, the display shows the functions selected prior to switching OFF.

## Measuring-functions:

The Ultra-Cal Mark III caliper has two distinctive functions:

- Function 1: This is an automatic condition after battery replacement whereby the mm/inch selection can be made and a zero setting made at any point.
- Function 2: Button (1) allows a memory set (hold) or the transmission of a measured value through the RS-232 output.

## Battery replacement

"Flip-off" the small panel (10) and (11) on the reverse side of the cover. Remove battery. When inserting the new battery, ensure that the (+) pole is positioned at the top. An inverted + pole cannot damage the electronic unit, it simply will not function.

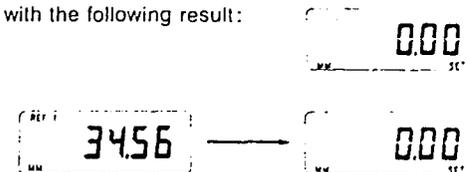
Replace the two small panels and reset the module.  
(Activate the button through reset port [9] with pointed object).

The display will show as described in function 1 with the following result:

## Measuring - using function 1:

### - Zero setting:

Press button (1) until the (REF 1) display point (6) appears. Release the button and zero will be displayed:



### - Changing the measuring format (mm/inch):

Press button (2) until the display (e.g. mm) is cleared. Release the button and the new format (e.g. inch) will be displayed.



### - Changing the mode:

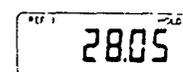
A prolonged press of button (2) is needed to obtain change of function as indicated by (5, 6).



## Measuring - using function 2

### - Memorizing a (HOLD) value:

A prolonged press of button (1) is needed to obtain the function "HOLD" on the display. The measured value is now retained until the "HOLD" is cleared. (Renewed pressing of button (1)).



*Note:* If the caliper is connected to a computer or printer using RS-232 output and the measured value is transmitted, the HOLD function will be cleared.

It is not possible to return to function 1 while "HOLD" is displayed.

### - Application of button (2):

Only a prolonged press of this button is needed to reset to function 1.

## Switching "OFF" the caliper display unit:

A prolonged press of button (1) will switch "OFF" the display. The actual "set" function has no influence.

The original value is retained providing the slide is not displaced.